Patent Claims

1. A security element for security papers, documents of value and the like having a thin-layer element (12) with color shift effect, which has a reflection layer (14), an absorber layer (18) and a spacer layer (16) disposed between reflection layer (14) and absorber layer (18), characterized in that the spacer layer (16) is formed by a printed layer having dispersion particles (20) with monomodal or oligomodal size distribution.

2. The security element according to claim 1, characterized in that the printed layer contains a main species of mainly spherical, monodisperse dispersion particles (20), the diameter of which determines the thickness of the spacer layer (16).

3. The security element according to claim 2, characterized in that the dispersion particles (20) of the main species have a diameter, which lies between about 100 nanometers and about 1500 nanometers, preferably between about 200 nanometers and about 500 nanometers.

4. The security element according to claim 2 or 3, characterized in that the printed layer comprises a monolayer or submonolayer of the dispersion particles (20) of the main species.

5. The security element according to at least one of claims 2 to 4, characterized in that the dispersion particles (20) of the main species have a melting temperature in the range of 50°C to 250°C.

6. The security element according to at least one of claims 2 to 5, characterized in that the dispersion particles (20) of the main species are formed of polystyrene, styrene-acrylonitrile copolymers (SAN), aromatic polyesters or polyamides.

7. The security element according to at least one of claims 2 to 4, characterized in that the dispersion particles (24) of the main species have a core-shell structure with a high-melting core (26) and an easily film-forming shell (28).

8. The security element according to claim 7, characterized in that the core (26) of the dispersion particles is formed of a hard polymer such as polystyrene, PMMA, styrene-acrylonitrile copolymers (SAN) or aromatic polyesters, and the shell (28) is formed of PMMA, polybutadiene or polyisoprene.

9. The security element according to at least one of claims 2 to 8, characterized in that the printed layer beside the dispersion particles (34) of the main species also contains dispersion particles (36) with smaller size, which are disposed in spaces (38) between the dispersion particles (34) of the main species.

10. The security element according to at least one of claims 1 to 9, characterized in that the reflection layer (14) is opaque.

11. The security element according to at least one of claims 1 to 10, characterized in that the reflection layer (14) is formed by a semitransparent metal layer.

12. The security element according to at least one of claims 1 to 10, characterized in that the reflection layer (14) is formed by a transparent reflection layer, which has a refractive index differing from that of the printed layer (16).

13. The security element according to at least one of claims 1 to 12, characterized in that the printed layer comprises two or a plurality of partial layers, which each contain mainly spherical, monodisperse dispersion particles with refractive indexes differing from each other.

14. The security element according to claim 13, characterized in that at least two partial layers are separated by a semitransparent metal layer.

15. The security element according to claim 13 or 14, characterized in that at least two partial layers are disposed directly one above the other.

16. The security element according to at least one of claims 1 to 15, characterized in that the thin-layer element (50) on the side of the reflection layer (56) facing away from the spacer layer (52) has a second absorber layer (60) and a second spacer layer (58) disposed between the second absorber layer (60) and the reflection layer (56), so that the result is a thin-layer element (50) with color shift effects visible from both sides, wherein the second spacer layer (58) is formed by a second printed layer having dispersion particles (64) with monomodal or oligomodal size distribution.

17. The security element according to claim 16, characterized in that the second printed layer contains a main species of mainly spherical, monodisperse dispersion particles (64), such as described in at least one of claims 3 to 9.

18. The security element according to claim 17, characterized in that the first and second printed layer (54, 58) each contain a main species (62, 64) with different diameters and/or different refractive indexes, so that from the two sides of the security element (50) different color shift effects are recognizable.

19. The security element according to at least one of claims 1 to 18, characterized in that in the spaces between the dispersion particles a matrix filling (30; 44) made of polymer material is disposed.

20. The security element according to at least one of claims 1 to 19, characterized in that the thin-layer element (80) is provided with an areal diffraction structure (84).

21. The security element according to claim 20, characterized in that the absorber layer (90), the spacer layer (92) and the reflection layer (96) are disposed in this order on a carrier (86, 88) having the areal diffraction structure (84).

22. The security element according to claim 20, characterized in that the reflection layer, the spacer layer and the absorber layer are disposed in this order on a carrier having the areal diffraction structure.

23. The security element according to at least one of claims 20 to 22, characterized in that the absorber layer (90) has a transmission of between 25% and 75%.

24. The security element according to at least one of claims 20 to 23, characterized in that the areal diffraction structure is formed by an embossed structure (86, 88).

25. The security element according to at least one of claims 1 to 24, characterized in that the security element (12; 50; 80) forms a security strip, a security thread, a security band, a patch or a transfer element for applying onto a security paper, document of value and the like.

26. A security paper for producing security documents, such as bank notes, ID cards or the like, which is provided with a security element (12; 50; 80) according to at least one of claims 1 to 25.

27. The security paper according to at least one of claims 16 to 18 and according to claim 26, with at least one window area or hole covered with the security element.

28. A document of value, such as bank note, ID card or the like, which is provided with a security element (12; 50; 80) according to at least one of claims 1 to 25.

29. The document of value (70) according to at least one of claims 16 to 18 and according to claim 27, with at least one window area or hole (72) covered with the security element (50).

30. A use of a security element according to at least one of claims 1 to 25, of a security paper according to claim 26 or 27, or of a document of value according to claim 28 or 29 for protecting goods of any kind.

31. A method for manufacturing a security element for security papers, documents of value and the like, which contains a thin-layer element with color shift effect that has a reflection layer, an absorber layer and a spacer layer disposed between reflection layer and absorber layer, characterized in that the spacer layer is applied with the help of a printing method with a printing ink having dispersion particles with monomodal or oligomodal size distribution.

32. The method according to claim 31, characterized in that the spacer layer is applied by gravure printing, flexographic printing, or offset printing.

33. The method according to claim 31 or 32, characterized in that a printing ink is used, which contains a main species of mainly spherical, monodisperse dispersion particles.

34. The method according to at least one of claims 31 to 33, characterized in that the solids content of the ink and the transferred amount are adjusted during the printing operation in such a way that on the reflection layer mainly a monolayer or submonolayer with the dispersion particles is formed.

35. The method according to at least one of claims 31 to 34, characterized in that the printed spacer layer is subjected to a temperature step, during which at least one constituent of the printing ink melts.

36. The method according to claim 35, characterized in that the printing ink contains dispersion particles, which melt during the temperature step.

37. The method according to claim 35, characterized in that the printing ink has dispersion particles having a core-shell structure with a high-melting core

and an easily film-forming shell, wherein the shells of the dispersion particles melt and form a film during the temperature step.

38. The method according to claim 35, characterized in that the printing ink besides a main species of dispersion particles, the diameter of which determines the thickness of the spacer layer, contains dispersion particles with smaller size, which melt and form a film during the temperature step.

39. The method according to at least one of claims 31 to 38, characterized in that the absorber layer, the spacer layer and the reflection layer are applied in this order onto a carrier having an areal diffraction structure.

40. The method according to at least one of claims 31 to 38, characterized in that the reflection layer, the spacer layer and the absorber layer are applied in this order onto a carrier having the areal diffraction structure.

41. The method according to claim 39 or 40, characterized in that the absorber layer is vapor-deposited onto the carrier or the spacer layer.

42. The method according to at least one of claims 31 to 38, characterized in that the thin-layer element on the side of the reflection layer facing away from the spacer layer has a second spacer layer and a second absorber layer, wherein the second spacer layer is applied by a printing method with a printing ink having dispersion particles with monomodal or oligomodal size distribution, so that a thin-layer element with color shift effects visible from the two sides is the result.

43. The method according to claim 42, characterized in that for the second spacer layer a printing ink is used, which contains a main species of mainly spherical, monodisperse dispersion particles.

44. The method according to claim 42 or 43, characterized in that for the first and second spacer layer printing inks are used, which each contain a main species with different diameters and/or different refractive indexes, so that

from the two sides of the thin-layer element different color shift effects are recognizable.

45. The method according to at least one of claims 31 to 44, characterized in that the printing of the spacer layer(s) is effected in a reel-fed fashion with a layer thickness uniform across the whole width of the roll.

46. A printing ink (100) with optically variable coloring pigments, which are formed by interference layer particles (102), the layer structure of which has a reflection layer, an absorber layer and a spacer layer disposed between reflection layer and absorber layer, wherein the spacer layer is formed by a printing method with dispersion particles having monomodal or oligomodal size distribution, or the layer structure of which comprises a first absorber layer (52), a first spacer layer (54), a reflection layer (56), a second spacer layer (58) and a second absorber layer (60), wherein the first spacer layer (54) is disposed between the reflection layer (56) and the first absorber layer (52), the second spacer layer (58) is disposed between the reflection layer (56) and the second absorber layer (60), and wherein the first and second spacer layer (54, 58) are formed by a first or second printed layer having dispersion particles (62, 64) with monomodal or oligomodal size distribution.

47. The printing ink (100) according to claim 46, characterized in that the first and second printed layer each contain a main species of mainly spherical, monodisperse dispersion particles (62, 64), the diameters of which determine the thickness of the first or second spacer layer (54, 58).

48. The printing ink (100) according to claim 47, characterized in that the dispersion particles (62, 64) of the main species of the first and/or second printed layer have a diameter, which lies between about 100 nanometers and about 1500 nanometers, preferably between about 200 nanometers and about 500 nanometers.

49. The printing ink (100) according to at least one of claims 46 to 48, characterized in that the first and/or second printed layer each comprises a monolayer or submonolayer of the dispersion particles (62, 64) of the main species.

50. The printing ink (100) according to at least one of claims 46 to 49, characterized in that the dispersion particles (62, 64) of the main species of the first and/ or second printed layer have a melting temperature in the range of 50°C to 250°C.

51. The printing ink (100) according to at least one of claims 46 to 50, characterized in that the dispersion particles (62, 64) of the main species of the first and/ or second printed layer are formed of polystyrene, styrene-acrylonitrile copolymers (SAN), aromatic polyesters or polyamides.

52. The printing ink (100) according to at least one of claims 46 to 49, characterized in that the dispersion particles of the main species of the first and/or second printed layer have a core-shell structure with a high-melting core and an easily film-forming shell.

53. The printing ink (100) according to claim 52, characterized in that the core of the dispersion particles is formed of a hard polymer, such as polystyrene, PMMA, styrene-acrylonitrile copolymers (SAN) or aromatic polyesters, and the shell of PMMA, polybutadiene or polyisoprene.

54. The printing ink (100) according to at least one of claims 46 to 49, characterized in that the first and/or second printed layer besides the dispersion particles of the main species also contains dispersion particles with smaller size, which are disposed in spaces between the dispersion particles of the main species.

55. A method for producing a printing ink having optically variable coloring pigments, wherein a thin-layer element with color shift effect is applied onto a substrate by applying a reflection layer, an absorber layer, and a spacer

layer onto the substrate, wherein the spacer layer is applied with the help of a printing method with dispersion particles having monomodal or oligomodal size distribution, the thin-layer element is removed from the substrate, the removed thin-layer element is ground into a predetermined particle size and the particles are mixed with a binding agent as optically variable coloring pigments.

56. A method for producing a printing ink with optically variable coloring pigments, wherein

a) onto a substrate a thin-layer element with color shift effect is applied by applying onto the substrate in this order a first absorber layer, a first spacer layer, a reflection layer, a second spacer layer and a second absorber layer,

   wherein the first and second spacer layer each are applied by a printing method with a printing ink having dispersion particles with monomodal or oligomodal size distribution,

b) the thin-layer element is removed from the substrate,

c) the removed thin-layer element is ground into a predetermined particle size, and

d) the particles are mixed with a binding agent as optically variable coloring pigments.

57. The method according to claim 55 or 56, characterized in that the spacer layers are applied by gravure printing, flexographic printing, or offset printing.

58. The method according to at least one of claims 55 to 57, characterized in that for the application of the spacer layers printing inks are used, which contain a main species of mainly spherical, monodisperse dispersion particles.

59. The method according to at least one of claims 55 to 58, characterized in that the solids content of the ink and the transferred portion are adjusted during the printing operation in such a way that on the reflection layer mainly a monolayer or submonolayer with the dispersion particles is formed.

60. The method according to at least one of claims 55 to 59, characterized in that after its application the printing ink is subjected to a temperature step, during which at least one constituent of the printing ink melts.

61. The method according to claim 60, characterized in that the printing ink contains dispersion particles, which melt during the temperature step.

62. The method according to claim 60, characterized in that the printing ink has dispersion particles having a core-shell structure with a high-melting core and an easily film-forming shell, wherein the shells of the dispersion particles melt and form a film during the temperature step.

63. The method according to claim 60, characterized in that the printing ink beside a main species of dispersion particles, the diameter of which determines the thickness of the spacer layer, contains dispersion particles with smaller size, which melt and form a film during the temperature step.